

Credit and borrowing

1



syllabus reference

Financial mathematics 4
• Credit and borrowing

In this chapter

- 1A Flat rate interest
- 1B Home loans
- 1C The cost of a loan
- 1D Credit cards
- 1E Loan repayments

Are you READY?

Try the questions below. If you have difficulty with any of them, extra help can be obtained by completing the matching **SkillsSHEET**. Either click on the **SkillsSHEET** icon next to the question on the *Maths Quest HSC Course* CD-ROM or ask your teacher for a copy.



1.1 Converting a percentage to a decimal

1 Convert each of the following percentages to decimals.

- | | | | |
|--------|--------------------|-------------------|---------|
| a 40% | b 12% | c 8% | d 2.4% |
| e 0.3% | f $7\frac{1}{2}\%$ | g $\frac{1}{4}\%$ | h 0.02% |



1.2 Finding a percentage of a quantity (money)

2 Find:

- | | | |
|-------------------|-------------------------------|---------------------|
| a 30% of \$5000 | b 5% of \$7390 | c 7.4% of \$125 000 |
| d 0.45% of \$3600 | e $\frac{1}{2}\%$ of \$82 000 | f 0.06% of \$78 000 |



1.3 Calculating simple interest

3 Calculate the simple interest earned on an investment of:

- | | |
|---|--------------------------------------|
| a \$7000 at 9% p.a. for 4 years | b \$57 500 at 6.5% p.a. for 2 years |
| c \$90 000 at $7\frac{1}{2}\%$ for $2\frac{1}{2}$ years | d \$60 000 at 5.2% p.a. for 9 months |



1.4 Finding values of n and r in financial formulas

4 Find the value of n and r for each of the following investments

- a Interest of 6% p.a. for 5 years with interest calculated annually
- b Interest of 9% p.a. for 4 years with interest calculated six-monthly
- c Interest of 8.8% p.a. for 3 years with interest calculated quarterly
- d Interest of 7.2% p.a. for 10 years with interest calculated monthly
- e Interest of 21% p.a. for June with interest calculated daily



1.5 Calculating compound interest

5 Use the formula $A = P(1 + r)^n$ to calculate the amount to which each of the following investments will grow.

- a \$7000 at 9% p.a. for 4 years with interest compounded annually
 - b \$75 000 at 6.2% p.a. for 6 years with interest compounded six-monthly
- Calculate the amount of compound interest earned on an investment of:
- c \$18 000 at 9.2% p.a. for 3 years with interest compounded annually
 - d \$150 000 at 8.4% p.a. for 10 years with interest compounded quarterly



1.6 Substitution into a formula

6 Evaluate each of the following by substituting into the given formula.

- a If $d = \frac{m}{v}$, find d when $m = 30$ and $v = 3$.
- b If $A = \frac{1}{2}(x + y)h$, find A when $h = 10$, $x = 7$ and $y = 2$.
- c If $s = ut + \frac{1}{2}at^2$, find s when $u = 0.8$, $t = 5$ and $a = 2.3$.

Flat rate interest

During the preliminary course we calculated the simple interest earned on investments. Flat rate interest is the borrowing equivalent of simple interest. Flat rate interest applies to many small loans and hire purchase agreements.

When money is borrowed from a lending institution such as a bank at a flat rate of interest, the total amount of interest is calculated as a percentage of the initial amount borrowed and then this is multiplied by the **term of the loan**. The term of the loan is the length of time which the loan is agreed to be repaid over.

The formula for calculating the amount of flat interest to be paid on a loan is the same formula as for simple interest (I):

$$I = Prn \quad \text{③}$$

where P = initial quantity

r = percentage interest rate per period expressed as a decimal

n = number of periods

As you work through the financial mathematics strand there are several formulas that use the same pronumerals.

While the initial quantity (P) will be the principal in an investing scenario, it will represent the amount borrowed in a loans situation.

All of these formulas use the same pronumerals and all of them require r to be expressed as a decimal. It should be part of your normal practice when doing such questions to convert the interest rate, expressed as a percentage, to a decimal. In simple or flat rate interest, r will always be a rate per annum or per year and there will be no variation on this regardless of how often interest is paid.

Similarly, n will always be the number of years of the investment or loan.

WORKED example 1

Calculate the flat interest to be paid on a loan of \$20 000 at 7.5% p.a. flat interest if the loan is to be repaid over 5 years.

THINK

- 1 Convert the interest rate to a decimal.
- 2 Write the formula.
- 3 Substitute the values of P , r (as a decimal) and n .
- 4 Calculate.

WRITE

$$\begin{aligned}
 r &= 7.5 \div 100 \\
 &= 0.075 \\
 I &= Prn \\
 &= \$20\,000 \times 0.075 \times 5 \\
 &= \$7500
 \end{aligned}$$

Once the interest has been calculated, we can calculate the total amount that must be repaid in a loan. This is calculated by adding the principal and the interest.

WORKED Example 2

Alvin borrows \$8000 to buy a car at a flat rate of 9% p.a. interest. Alvin is to repay the loan, plus interest, over 4 years. Calculate the total amount that Alvin is to repay on this loan.

THINK

- 1 Convert the interest rate to a decimal.
- 2 Write the interest formula.
- 3 Substitute the values of P , r and n .
- 4 Calculate the interest.
- 5 Calculate the total repayments by adding the interest and principal.

WRITE

$$r = 9 \div 100 \\ = 0.09$$

$$I = Prn$$

$$= \$8000 \times 0.09 \times 4 \\ = \$2880$$

$$\text{Total repayments} = \$8000 + \$2880 \\ = \$10\,880$$



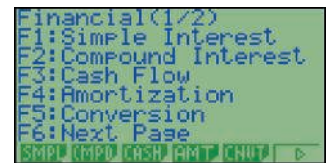
Graphics Calculator tip!

Calculate simple interest

Your Casio graphics calculator can perform a number of financial functions by using the **TVM** mode.

One of the options in this mode is to calculate simple interest. Examples such as worked example 2 above are more simply done using the arithmetic method as shown above. However, for some of the more complex questions later in this chapter it is worth familiarising yourself with this method.

1. From the **MENU** select **TVM**.
2. Press **(F1)** to select **Simple Interest**.
3. The calculator has two modes of calculating interest: 360 day mode or 365 day mode. You need to make sure that it is on 365 day mode. If not, press **(SHIFT)** **[SET UP]**, select **Date Mode** and press **(F1)** for 365.
4. Press **(EXE)** to return to the previous screen and enter the data for worked example 2.
 $n = 4 \times 365$ (as n is in days)
 $i\% = 9$
 $PV = -8000$
 (principal or present value is entered as a negative)



5. The calculator gives you two options.

Press **(F1) (SI)** for simple interest

Press **(F2) (SFV)** for future value (in other words, the principal plus interest).

In this example we want the total repayments, so we press **(F2) (SPV)**.



Most loans are repaid on a monthly basis. Once the total amount to be repaid has been calculated, this can be divided into equal monthly, fortnightly or weekly instalments.

WORKED Example 3

Narelle buys a computer on hire purchase. The cash price of the computer is \$3000, but Narelle must pay a 10% deposit with the balance paid at 8% p.a. flat rate interest in equal monthly instalments over 3 years.

- a** Calculate the deposit.
- b** Calculate the balance owing.
- c** Calculate the interest on the loan.
- d** Calculate the total amount to be repaid.
- e** Calculate the amount of each monthly instalment.

THINK

- a** Find 10% of \$3000.
- b** Subtract the deposit from the cash price to find the amount borrowed.
- c**
 - ① Write the interest formula.
 - ② Substitute for P , r and n .
 - ③ Calculate the interest.
- d** Add the interest to the amount borrowed.
- e** Divide the total repayments by 36 (the number of monthly instalments in 3 years).

WRITE

- a** $\text{Deposit} = 10\% \text{ of } \3000
 $= \$300$
- b** $\text{Balance} = \$3000 - \300
 $= \$2700$
- c** $I = Prn$
 $= \$2700 \times 0.08 \times 3$
 $= \$648$
- d** $\text{Total repayments} = \$2700 + \$648$
 $= \$3348$
- e** $\text{Monthly repayments} = \$3348 \div 36$
 $= \$93.00$

If given the amount to be repaid each month, we can calculate the interest rate. The interest on the loan is the difference between the total repaid and the amount borrowed. This is then calculated as a yearly amount and written as a percentage of the amount borrowed.

WORKED Example 4

Theresa borrows \$12 000 to buy a car. This is to be repaid over 5 years at \$320 per month. Calculate the flat rate of interest that Theresa has been charged.

THINK

- 1 Calculate the total amount that is repaid.
- 2 Subtract the principal from the total repayments to find the interest.
- 3 Calculate the interest paid each year.
- 4 Write the annual interest as a percentage of the amount borrowed.

WRITE

$$\begin{aligned}\text{Total repayments} &= \$320 \times 60 \\ &= \$19\,200\end{aligned}$$

$$\begin{aligned}\text{Interest} &= \$19\,200 - \$12\,000 \\ &= \$7200\end{aligned}$$

$$\begin{aligned}\text{Interest per year} &= \$7200 \div 5 \\ &= \$1440\end{aligned}$$

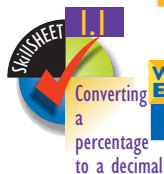
$$\begin{aligned}\text{Interest rate} &= \frac{\$1440}{\$12\,000} \times 100\% \\ &= 12\%\end{aligned}$$

remember

1. Flat rate interest is the borrowing equivalent of simple interest. It is calculated based on the initial amount borrowed.
2. The simple interest formula is used to calculate the amount of flat rate interest to be paid on a loan. The simple interest formula is $I = Prn$.
3. The total amount to be repaid on a loan is the principal plus interest. To calculate the amount of each instalment, we divide the total amount by the number of repayments.
4. When given the amount of each instalment, we can calculate the flat rate of interest.

EXERCISE 1A

Flat rate interest



WORKED Example 1

- 1 Calculate the amount of flat rate interest paid on each of the following loans.
 - a \$5000 at 7% p.a. for 2 years
 - b \$8000 at 5% p.a. for 3 years
 - c \$15 000 at 10% p.a. for 5 years
 - d \$9500 at 7.5% p.a. for 4 years
 - e \$2500 at 10.4% p.a. for 18 months



WORKED Example 2

- 2 Roula buys a used car that has a cash price of \$7500. She has saved a deposit of \$2000 and borrows the balance at 9.6% p.a. flat rate to be repaid over 3 years. Calculate the amount of interest that Roula must pay.
- 3 Ben borrows \$4000 for a holiday. The loan is to be repaid over 2 years at 12.5% p.a. flat interest. Calculate the total repayments that Ben must make.
- 4 Calculate the total amount to be paid on each of the following flat rate interest loans.
 - a \$3500 at 8% p.a. over 2 years
 - b \$13 500 at 11.6% p.a. over 5 years
 - c \$1500 at 13.5% p.a. over 18 months
 - d \$300 at 33% p.a. over 1 month
 - e \$100 000 at 7% p.a. over 25 years



- 5 Mr and Mrs French purchase a new lounge suite, which has a cash price of \$5500. They purchase the lounge on the following terms: 30% deposit with the balance to be repaid at 9% p.a. flat interest over 2 years. Calculate:

- a the deposit
- b the balance owing
- c the interest to be paid
- d the total amount that they pay for the lounge.



**WORKED
Example**
3

- 6 Yasmin borrows \$5000 from a credit union at a flat interest rate of 8% p.a. to be repaid over 4 years in equal monthly instalments. Calculate:

- a the interest that Yasmin must pay on the loan
- b the total amount that Yasmin must repay
- c the amount of each monthly repayment.

- 7 Ian borrows \$2000 from a pawnbroker at 40% p.a. interest. The loan is to be paid over 1 year in equal weekly payments.

- a Calculate the interest on the loan.
- b Calculate the total that Ian must repay.
- c Calculate Ian's weekly payment.

- 8 The Richards family purchase an entertainment system for their home. The total cost of the system is \$8000. They buy the system on the following terms: 25% deposit with the balance repaid over 3 years at 12% p.a. flat interest in equal monthly instalments. Calculate:

- a the deposit
- b the balance owing
- c the interest on the loan
- d the total repayments
- e the amount of each monthly repayment.

- 9 Sam buys an electric guitar with a cash price of \$1200. He buys the guitar on the following terms: one-third deposit, with the balance at 15% p.a. flat interest over 2 years in equal monthly instalments. Calculate the amount of each monthly repayment.

10 **multiple choice**

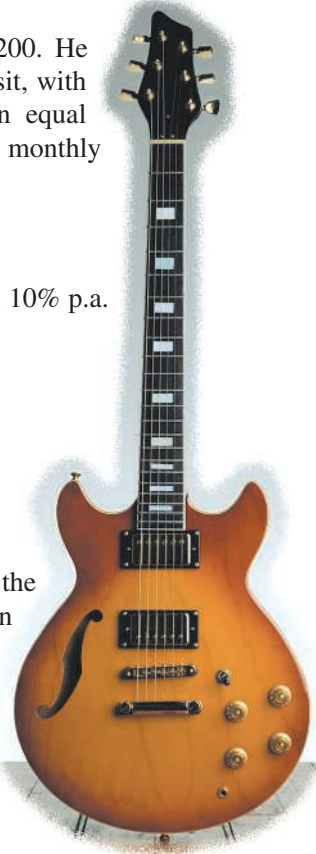
The amount of flat rate interest on a loan of \$10 000 at 10% p.a. for 2 years is:

- A \$1000
- B \$2000
- C \$11 000
- D \$12 000

11 **multiple choice**

A refrigerator with a cash price of \$1800 is bought on the following terms: 20% deposit with the balance paid in 12 equal monthly instalments at 12% p.a. flat interest. The total cost of the refrigerator when purchased on terms is:

- A \$172.80
- B \$216.00
- C \$1972.80
- D \$2016.00



**WORKED
Example**
4

- 12 Andy borrows \$4000, which is to be repaid over 4 years at \$110 per month. Calculate the flat rate of interest that Andy has been charged.
- 13 Sandra buys a used car with a cash price of \$12 000 on the following terms: 20% deposit with the balance paid at \$89.23 per week for 3 years. Calculate:
- the deposit
 - the balance owing
 - the total cost of the car
 - the flat rate of interest charged.
- 14 Calculate the flat rate of interest charged on a lounge suite with a cash price of \$5000 if it is purchased on the following terms: 15% deposit with the balance paid at \$230.21 per month for 2 years.



Computer Application 1 Flat rate interest loan calculator

Access the spreadsheet *Flat Interest* from the *Maths Quest General Mathematics HSC Course* CD-ROM. This spreadsheet will demonstrate how to calculate a deposit, the total repayments on a loan and the size of each repayment.

Monthly payment calculator

Consider a \$5000 loan to be repaid at 9% p.a. flat rate interest over 3 years.

- On the sheet titled 'Monthly Payments', in cell **B5** enter the amount which has been borrowed (\$5000), or the balance owing on a purchase after the deposit has been paid.
- In cell **B7** enter the interest rate as a percentage (9%).
- In cell **B9** enter the number of years over which the loan is to be repaid (3).

	A	B	C	D	E	F	G	H	I	J	K	
1	Flat Rate Interest Calculator											
2												
3	Monthly Repayment Calculator											
4												
5	Amount Borrowed	\$5,000										
6												
7	Interest Rate	9%										
8												
9	Term	3										
10												
11	Total Interest	\$1,350										
12												
13	Total Repayments	\$6,350										
14												
15	Monthly Repayment	\$176.39										
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												



- The total interest paid on the loan will be displayed in cell **B11**. The formula for this will be displayed in this cell.
- Cell **B13** shows the total amount to be repaid and cell **B15** shows the amount of each repayment.

Flat interest rate calculator

The worksheet 'Flat Interest Rate' will calculate the flat rate of interest charged given the amount of each repayment. Consider a \$15 000 loan that is repaid over 5 years at \$350 per month.

- In cell **B5** enter the amount borrowed (\$15 000).
- In cell **B7** enter the amount of each monthly payment (\$350).
- In cell **B9** enter the total number of monthly payments (60).

	A	B	C	D	E	F	G	H	I	J	K	
1	Flat Rate Interest Calculator											
2	Flat Rate Interest Calculator											
3												
4												
5	Amount Borrowed	\$15,000										
6												
7	Monthly Payment	\$350										
8												
9	No. of Payments	60										
10												
11	Total Repayments	\$21,000										
12												
13	Total Interest	\$6,000										
14												
15	Yearly Interest	\$1,200										
16												
17	Flat Interest Rate	8%										
18												
19												
20												
21												
22												
23												
24												
25												

- Displayed will be the total amount to be repaid (cell **B11**), the total interest paid on the loan (cell **B13**), the amount of interest paid per year (cell **B15**) and the flat rate of interest (cell **B17**).

Check your answers to the previous exercise using this spreadsheet.

Home loans

The biggest loan that most people will ever take out will be for a home. These loans are usually for large amounts of money and are taken over long periods of time. Most commonly they are taken over 10, 15, 20 or 25 years but they can be taken over even longer periods of up to 35 years.

Home loans are not charged at a flat rate of interest. The interest on these loans is reducible, which means that the interest is calculated on the amount of money owing on the loan at the time rather than on the amount initially borrowed. This is known as a **reducing balance loan**.

The interest on a home loan is usually calculated at the beginning of each month, and payments are calculated on a monthly basis. So each month interest is added to the loan and a payment is subtracted from the balance owing. The balance increases by the amount of interest and then decreases by the amount of each payment.

Consider the case of a person who borrows \$250 000 to buy a home at 9% p.a. reducible interest. The monthly repayment on this loan is \$2500 per month. The interest rate of 9% p.a. converts to 0.75% per month.

$$\begin{aligned}\text{First month's interest} &= 0.75\% \text{ of } \$250\,000 \\ &= \$1875\end{aligned}$$

$$\begin{aligned}\text{Balance owing} &= \$250\,000 + \$1875 - \$2500 \\ &= \$249\,375\end{aligned}$$

In the second month the interest is calculated on the balance owing at the end of the first month.

$$\begin{aligned}\text{Second month's interest} &= 0.75\% \text{ of } \$249\,375 \\ &= \$1870.31\end{aligned}$$

$$\begin{aligned}\text{Balance owing} &= \$249\,375 + \$1870.31 - \$2500 \\ &= \$248\,745.31\end{aligned}$$

The progress of this loan can be followed in the following computer application.

Computer Application 2 Home loan calculator

Access the spreadsheet *Home Loan* from the Maths Quest General Mathematics HSC Course CD-ROM. This spreadsheet will allow you to follow the progress of a home loan as it is paid off.



Microsoft Excel - Home loan

File Edit View Insert Format Tools Data Window Kadd Help

Type a question for help

Arial 10 B I U

F22

	A	B	C	D	E	F	G	H	I	J	K
1	Home Loan Table										
2											
3											
4		Amount borrowed	\$250,000.00								
5		Interest rate (p.a.)	9%	Monthly interest rate	0.0075						
6		Monthly repayment	\$2,500.00								
7											
8	Month	Principal	Interest	Balance owing							
9	1	\$250,000.00	\$1,875.00	\$249,375.00							
10	2	\$249,375.00	\$1,870.31	\$248,745.31							
11	3	\$248,745.31	\$1,865.59	\$248,110.90							
12	4	\$248,110.90	\$1,860.83	\$247,471.73							
13	5	\$247,471.73	\$1,856.04	\$246,827.77							
14	6	\$246,827.77	\$1,851.21	\$246,178.98							
15	7	\$246,178.98	\$1,846.34	\$245,525.32							
16	8	\$245,525.32	\$1,841.44	\$244,866.76							
17	9	\$244,866.76	\$1,836.50	\$244,203.26							
18	10	\$244,203.26	\$1,831.52	\$243,534.79							
19	11	\$243,534.79	\$1,826.51	\$242,861.30							
20	12	\$242,861.30	\$1,821.46	\$242,182.76							
21											
22											
23											
24											

Sheet1 / Sheet2 / Sheet3 /

Ready NUM

Use the **Edit** and then the **Fill** and **Down** functions on columns A, B, C and D. Look down column D to find when the balance owing becomes 0 or when it becomes negative. At this time the loan will have been fully repaid.

Examine other loans by changing the data in **C4**, **C5** and **C6**.

WORKED Example 5

Mr and Mrs Chan take out a \$100 000 home loan at 8% p.a. reducible interest over 25 years. Interest is calculated and added on the first of each month. They make a payment of \$775 each month. Calculate:

- a the interest added after one month
- b the balance owing after one month.

THINK

- a ① Convert 8% p.a. to a monthly rate.
- ② Calculate $\frac{2}{3}\%$ of \$100 000 to find the interest for one month.
- b Add the interest to the principal and subtract the repayment.

WRITE

$$a \quad 8\% \text{ p.a.} = \frac{2}{3}\% \text{ per month}$$

$$\begin{aligned} \text{Interest} &= \frac{2}{3}\% \text{ of } \$100\,000 \\ &= \$666.67 \end{aligned}$$

$$b \quad \text{Balance owing} = \$100\,000 + \$666.67 - \$775 = \$99\,891.67$$

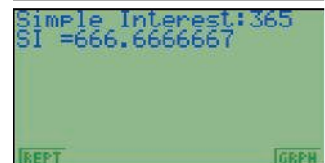
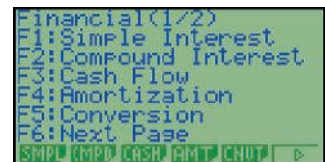


Graphics Calculator tip!

Calculate the interest in a one-month period

We can use the **TVM** function to calculate the interest for a one-month period but great care needs to be taken. Remembering that the interest is calculated for a number of days, to calculate monthly interest we need to enter $n = 365 \div 12$. Consider the method shown below for worked example 5.

- From the **MENU** select **TVM**.
- Press **(F1)** to select **Simple Interest**.
- $n = 365 \div 12$ (as n is in days)
 $I\% = 8$
 $PV = -100000$
- Press **(F1) (SI)** to find the interest for one month.



When interest is calculated every year for such a long period of time, as with many home loans, the amount of money required to pay off such a loan can be a great deal more than the initial loan.

WORKED Example 6

A loan of \$120 000 is paid off at 9% p.a. reducible interest over a period of 25 years. The monthly repayment is \$1007.04. Calculate the total amount made in repayments on this loan.

THINK

- 1 Calculate the number of repayments by multiplying the number of years by 12.
- 2 Multiply the monthly repayment by the number of repayments.

WRITE

$$\begin{aligned}\text{No. of repayments} &= 25 \times 12 \\ &= 300\end{aligned}$$

$$\begin{aligned}\text{Total repayments} &= \$1007.04 \times 300 \\ &= \$302\,112.00\end{aligned}$$

remember

1. The interest on home loans is calculated at a reducible rate. This means that the interest is calculated on the balance owing rather than the initial amount borrowed.
2. Interest is calculated each month; this is then added to the principal and a payment is made. The interest next month is then calculated on the new amount owing.
3. To calculate the total amount to be repaid on a home loan, we multiply the monthly payment by the number of repayments made.

EXERCISE 1B**Home loans****WORKED Example 5**

- 1 Mr and Mrs Devcich borrow \$80 000 to buy a home. The interest rate is 12% p.a. and their monthly payment is \$850 per month.
 - a Calculate the interest for the first month of the loan.
 - b Calculate the balance owing at the end of the first month.
- 2 The repayment on a loan of \$180 000 at 7.5% p.a. over a 15-year term is \$1668.62 per month.
 - a Calculate the interest for the first month of the loan and the balance owing at the end of the first month.
 - b Calculate the amount by which the balance has reduced in the first month.



- c Calculate the interest for the second month of the loan and the balance at the end of the second month.
 - d By how much has the balance of the loan reduced during the second month?
- 3 The repayment on a loan of \$150 000 over a 20-year term at 9.6% p.a. is \$1408.01 per month. Copy and complete the table below.

Month	Principal (\$)	Interest (\$)	Balance (\$)
1	150 000.00	1200.00	149 791.99
2	149 791.99		
3			
4			
5			
6			
7			
8			
9			
10			

- 4 Mr and Mrs Roebuck borrow \$255 000 to purchase a home. The interest rate is 9% p.a. and over a 25-year term the monthly repayment is \$2294.31.
- a Copy and complete the table below.

Month	Principal (\$)	Interest (\$)	Balance (\$)
1	255 000.00	1912.50	254 618.19
2	254 618.19		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

- b Mr and Mrs Roebuck decide to increase their monthly payment to \$2500. Complete the table below.

Month	Principal (\$)	Interest (\$)	Balance (\$)
1	255 000.00	1912.50	254 412.50
2	254 412.50		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

- c How much less do Mr and Mrs Roebuck owe at the end of one year by increasing their monthly repayment?

**WORKED
Example**

6

- 5 The repayments on a loan of \$105 000 at 8% p.a. reducible interest over 25 years are \$810.41 per month. Calculate the total repayments made over the life of the loan.
- 6 The Taylors borrow \$140 000 over 20 years at 9% p.a.
- The monthly repayment on this loan is \$1259.62. Calculate the total repayments.
 - The Taylors attempt to pay the loan off quickly by increasing their monthly payment to \$1500. The loan is then paid off in 161 months. Calculate the total repayments made under this plan.
 - How much will the Taylors save by increasing each monthly payment?

7 **multiple choice**

The first month's interest on a \$60 000 home loan at 12% p.a. reducible interest is:

- A \$600 B \$7200 C \$60 600 D \$67 200

8 **multiple choice**

A \$95 000 loan at 8% p.a. reducible interest over a 15-year term has a monthly payment of \$907.87. The total amount of interest paid on this loan is:

- A \$7600 B \$68 416.60 C \$114 000 D \$163 416.60

- 9 Mr and Mrs Chakraborty need to borrow \$100 000 to purchase a home. The interest rate charged by the bank is 7% p.a. Calculate the total interest paid if the loan is taken over each of the following terms:
- \$706.78 per month over a 25-year term
 - \$775.30 per month over a 20-year term
 - \$898.83 per month over a 15-year term
 - \$1161.08 per month over a 10-year term.

- 10** The Smith and Jones families each take out a \$200 000 loan at 9.5% p.a. reducible interest. The Smith family repay the loan at \$2000 per month and the Jones family repay the loan at \$3000 per month.

- a** How much does each family make in repayments in the first year?
b Complete the table below for each family.

Smith family			
Month	Principal (\$)	Interest (\$)	Balance (\$)
1	200 000.00	1583.33	199 583.33
2	199 583.33		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Jones family			
Month	Principal (\$)	Interest (\$)	Balance (\$)
1	200 000.00	1583.33	198 583.33
2	198 583.33		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

- c** After one year how much less does the Jones family owe than the Smith family?

10 QUICK QUESTIONS 1

- 1 Calculate the amount of flat rate interest payable on a loan of \$1500 at 14% p.a. to be repaid over 2 years.
- 2 Calculate the amount of flat rate interest payable on a loan of \$2365 at 19.2% p.a. to be repaid over $2\frac{1}{2}$ years.
- 3 Calculate the total repayments on a loan of \$5000 at 13.5% p.a. to be repaid over 3 years.
- 4 Susan buys a lounge suite on terms. The cash price of the lounge is \$6500 and she pays a 15% deposit. Calculate the amount of the deposit.
- 5 Calculate the balance that Susan owes on the lounge suite.
- 6 Calculate the interest that Susan will pay at 17% p.a. flat rate interest for a period of 3 years.
- 7 Calculate the total amount that Susan will have to repay.
- 8 Calculate the monthly repayment that Susan will need to make.
- 9 Harry and Sally borrow \$164 000 to purchase a home. The interest rate is 12% p.a. Calculate the amount of interest payable for the first month.
- 10 A \$175 000 loan that is repaid over 25 years has a monthly repayment of \$1468.59. Calculate the total amount of interest that is paid on this loan.

The cost of a loan

Because of the different ways that interest can be calculated, the actual interest rate quoted may not be an accurate guide to the cost of the loan. By using a flat rate of interest, a lender can quote an interest rate less than the equivalent reducible interest rate.

To compare flat and reducible rates of interest, we need to calculate the effective rate of interest for a **flat rate loan**. The effective rate of interest is the equivalent rate of reducible interest for a flat rate loan.

The formula for effective rate of interest is:

$$E = \frac{(1 + r)^n - 1}{n}$$

where E = effective rate of interest, expressed as a decimal

r = stated rate of flat interest expressed as a decimal

n = term of the loan in years

Note: This formula for effective rate of interest is *not* on your formula sheet. This does not mean that you have to memorise it as the formula will be given to you as a part of any question that requires you to use it.

WORKED Example 7

Andrea takes out an \$8000 loan for a car over 5 years at 6% p.a. flat rate interest. Calculate the effective rate of interest charged on the loan.

THINK

- 1 Write the formula.
- 2 Substitute $r = 0.06$ and $n = 5$.
- 3 Calculate.
- 4 Write the interest rate as a percentage.

WRITE

$$\begin{aligned}
 E &= \frac{(1+r)^n - 1}{n} \\
 &= \frac{(1.06)^5 - 1}{5} \\
 &= 0.068
 \end{aligned}$$

The effective rate of interest is 6.8% p.a.



A loan with a reducible rate of interest can be compared to a flat rate of interest if we are able to calculate the total repayments made over the term of the loan.

WORKED Example 8

An \$85 000 loan at 10% p.a. reducible interest is to be repaid over 15 years at \$913.41 per month.

- a Calculate the total repayments on the loan.
- b Calculate the total amount of interest paid.
- c Calculate the equivalent flat rate of interest on this loan.

THINK

- a Multiply the monthly repayments by the number of months taken to repay the loan.
- b Subtract the initial amount borrowed from the total repayments.
- c
 - 1 Calculate the amount of interest paid per year.
 - 2 Write the yearly interest as a percentage of the amount borrowed.

WRITE

$$\begin{aligned}
 \text{a Total repayments} &= \$913.41 \times 180 \\
 &= \$164\,413.80
 \end{aligned}$$

$$\begin{aligned}
 \text{b Interest} &= \$164\,413.80 - \$85\,000 \\
 &= \$79\,413.80
 \end{aligned}$$

$$\begin{aligned}
 \text{c Annual interest} &= \$79\,413.80 \div 15 \\
 &= \$5294.25
 \end{aligned}$$

$$\begin{aligned}
 \text{Flat interest rate} &= \frac{\$5294.25}{\$85\,000} \times 100\% \\
 &= 6.2\% \text{ p.a.}
 \end{aligned}$$

The most accurate way to compare loans is to calculate the total repayments made in each loan.

WORKED Example 9

Allison borrows \$6000 and has narrowed her choice of loans down to two options.

Loan A: At 8% p.a. flat rate interest over 4 years to be repaid at \$165.00 per month.

Loan B: At 12% p.a. reducible interest over 3 years to be paid at \$199.29 per month.

Which of the two loans would cost Allison less?

THINK

- 1 Calculate the total repayments on Loan A.
- 2 Calculate the total repayments on Loan B.
- 3 Write a conclusion.

WRITE

$$\begin{aligned}\text{Loan A repayments} &= \$165.00 \times 48 \\ &= \$7920\end{aligned}$$

$$\begin{aligned}\text{Loan B repayments} &= \$199.29 \times 36 \\ &= \$7174.44\end{aligned}$$

Loan B would cost \$745.56 less than Loan A.

In the above example Allison should take Loan B even though it has a much higher advertised interest rate. This of course would depend upon Allison's ability to meet the higher monthly payments.

Generally the more quickly that you can pay off a loan the cheaper the loan will be. The savings are particularly evident when examining home loans. Some home loans that offer a lower interest rate allow for you to make only the minimum monthly repayment. This will maximise the amount of interest that the customer will pay.

If a person can afford to pay more than the minimum amount, they may be better off over time by paying a slightly higher rate of interest and paying the loan off over a shorter period of time.

WORKED Example 10

Mr and Mrs Beasley need to borrow \$100 000 and have the choice of two home loans.

Loan X: 6% p.a. over 25 years with a fixed monthly repayment of \$644.30. No extra repayments are allowed on this loan.

Loan Y: 7% p.a. over 25 years with a minimum monthly payment of \$706.78.

Mr and Mrs Beasley believe they can afford to pay \$800 per month on this loan. If they do, the loan will be repaid in 18 years and 9 months. Which loan would you recommend?

THINK

- 1 Calculate the total repayments on Loan X.
- 2 Calculate the total repayments on Loan Y.
- 3 Make a recommendation.

WRITE

$$\begin{aligned}\text{Loan X repayments} &= \$644.30 \times 300 \\ &= \$193\,290\end{aligned}$$

$$\begin{aligned}\text{Loan Y repayments} &= \$800 \times 225 \\ &= \$180\,000\end{aligned}$$

Mr and Mrs Beasley should choose Loan Y as they will save \$13 290 provided they can continue to pay \$800 per month.

With loans such as the one in the above example, the savings depend upon the ability to make the extra repayments. If this is doubtful, Loan X would have been the safer option.

The other factor to consider when calculating the cost of a loan is fees. Many loans have a monthly management fee attached to them. This will need to be calculated into the total cost and may mean that a loan with a slightly higher interest rate but no fee may be a cheaper option.

remember

1. The actual cost of a loan is calculated by the total cost in repaying the loan. The interest rate is a guide but not the only factor in calculating cost.
2. A loan that is quoted at a flat rate of interest can be compared to a reducible rate of interest only by calculating the effective rate of interest on the flat rate loan. The effective rate of interest is the equivalent reducible rate of interest and is found using the formula:

$$E = \frac{(1 + r)^n - 1}{n}$$

3. By calculating the total repayments on a loan, we can calculate the equivalent flat rate of interest paid on the loan.
4. A loan that is repaid over a shorter period of time will usually cost less than one where the repayments are made over the full term of the loan.
5. The flexibility of a loan, which includes factors such as whether extra repayments can be made, is important when considering the cost of a loan.
6. When calculating the cost of a loan, any ongoing fees need to be calculated.

EXERCISE 1C

The cost of a loan

WORKED Example

7

- 1 A \$15 000 loan is to be repaid at 8% p.a. flat rate interest over a 10-year term.

Use the formula $E = \frac{(1 + r)^n - 1}{n}$ to calculate the effective rate of interest.

- 2 Calculate the effective rate of interest on each of the following flat rate loans.
- | | | |
|---------------------------|--------------------------|-------------------------|
| a 10% p.a. over 4 years | b 8% p.a. over 2 years | c 12% p.a. over 5 years |
| d 7.5% p.a. over 10 years | e 9.6% p.a. over 6 years | |
- 3 A bank offers loans at 8% p.a. flat rate of interest. Calculate the effective rate of interest for a loan taken over:
- | | | |
|-----------|------------|-------------|
| a 2 years | b 3 years | c 4 years |
| d 5 years | e 10 years | f 20 years. |

WORKED Example

8

- 4 An \$85 000 home loan at 9% p.a. reducible interest is to be repaid over 25 years at \$713.32 per month.
- a Calculate the total repayments on the loan.
 - b Calculate the total amount of interest paid.
 - c Calculate the equivalent flat rate of interest on the loan.
- 5 Calculate the equivalent flat rate of interest paid on a \$115 000 loan at 12% p.a. reducible interest to be repaid over 30 years at \$1182.90 per month.

1.6

SkillSheet

Substitution
into a
formula

EXCEL Spreadsheet

Effective
rate of
interest

**WORKED
Example****9**

- 6 Kim borrows \$12 000 for a holiday to South-East Asia. She is faced with a choice of two loans.
Loan I: At 10% p.a. flat rate of interest over 2 years to be repaid at \$600 per month.

Loan II: At 12.5% p.a. reducible interest over 3 years to be repaid at \$401.44 per month.

Which loan will cost Kim the least money?

- 7 Calculate the total cost of repaying a loan of \$100 000 at 8% p.a. reducible interest:
- over 25 years with a monthly repayment of \$771.82
 - over 20 years with a monthly repayment of \$836.44
 - over 10 years with a monthly repayment of \$1213.28.

**WORKED
Example****10**

- 8 Masako and Toshika borrow \$125 000 for their home. They have the choice of two loans.

Loan 1: A low interest loan at 7% p.a. interest over 25 years with fixed repayments of \$833.47 per month.

Loan 2: A loan at 7.5% p.a. interest over 25 years with minimum repayments of \$923.74 per month.

Masako and Toshika believe they can afford to pay \$1000 per month. If they do, Loan 2 will be repaid in 20 years and 4 months.

Which loan should they choose if they could afford to pay the extra each month?

9 multiple choice

A loan can be taken out at 8% p.a. flat interest or 9% p.a. reducible interest. Using the formula $E = \frac{(1+r)^n - 1}{n}$, the number of years of the loan (n) after which the effective

rate of interest on the flat rate loan becomes greater than the reducible rate loan is:

- A** 2 years **B** 3 years **C** 4 years **D** 5 years

- 10 Glenn and Inge are applying for a \$150 000 loan to be repaid over 25 years.
- Bank A charges 7.8% p.a. interest, no fees, with the loan to be repaid at \$1137.92 per month. Calculate the total cost of this loan.
 - Bank B charges 7.6% p.a. interest, a \$600 loan application fee, a \$5 per month management fee and repayments of \$1118.26 per month. Calculate the total cost of this loan.

11 multiple choice

A \$50 000 loan is to be taken out. Which of the following loans will have the lowest total cost?

- 5% p.a. flat rate interest to be repaid over 10 years
- 8% p.a. reducible interest to be repaid over 10 years at \$606.64 per month
- 6% p.a. reducible interest to be repaid over 12 years at \$487.93 per month
- 6.5% p.a. reducible interest to be repaid over 10 years at \$567.74 per month, with a \$600 loan application fee and \$8 per month account management fee



- 12** A home loan of \$250 000 is taken out over a 20-year term. The interest rate is 9.5% p.a. and the monthly repayments are \$2330.33.
- a** The mortgage application fee on this loan was \$600 and there is a \$10 per month account management fee. Calculate the total cost of repaying this loan.
 - b** Calculate the equivalent flat rate of interest on the loan. (Consider the extra payments as part of the interest.)
 - c** If the loan is repaid at \$3000 per month, it will take $11\frac{1}{2}$ years to repay the loan. Calculate the equivalent flat rate of interest if this repayment plan is followed.



Graphics Calculator **tip!**

Loan repayment function

Your Casio graphics calculator can calculate the amount of each monthly repayment on a home loan when given the term of the loan and the interest rate. The **PMT** function, which is under the compound interest menu, allows for such calculations to be made.

Consider a loan of \$250 000 to be repaid over 25 years at 8% p.a. with interest added and repayments made monthly. We wish to find the amount of each monthly repayment.

1. From the **MENU** select **TVM**.



2. Press **(F2)** to select **Compound Interest**.



3. Enter the following settings.

$$n = 25 \times 12$$

$$I\% = 8$$

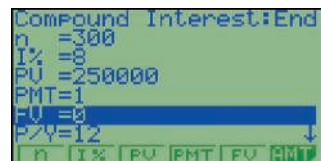
$$PV = 250000$$

$$PMT = 1$$

$$FV = 0$$

$$P/Y = 12 \text{ (payments per year)}$$

$$C/Y = 12 \text{ (You will need to scroll to see this.)}$$



4. Press **(F4)** (**PMT**) to find the amount of each monthly repayment, which will be displayed as a negative.



Researching home loans

- 1 Suppose that you wish to borrow \$100 000 to buy a home. Go to a bank or other lender and gather the following information.
 - a The annual interest rate
 - b The loan application fee and any other costs such as stamp duty, legal costs etc. associated with establishing the loan
 - c Is there a monthly account keeping or management fee?
 - d The monthly repayment if the loan is repaid over:
 - i 15 years
 - ii 20 years
 - iii 25 years
 - e The total cost of repaying the loan in each of the above examples
- 2 There are many ways that people can reduce the overall cost of repaying a mortgage. Research and explain why people are able to save money by adopting the following repayment strategies.
 - a Repaying the loan fortnightly or weekly instead of monthly
 - b Using an account where the whole of a person's net pay is deposited on the mortgage and then a redraw is used to meet living expenses

Credit cards

Credit cards are the most common line of day-to-day credit that most people use. A credit card works as a pre-approved loan up to an amount agreed upon by the customer and the bank. The card can then be used until the amount of the debt reaches this limit.

As with other types of loan, the bank charges interest upon the amount that is owed on the card and repayments must be made monthly. The way in which the interest is calculated varies with different types of credit cards.

Some cards have interest charged from the day on which the purchase was made. Others have what is called an interest-free period. This means that a purchase that is made will appear on the next monthly statement. Provided that this amount is paid by the due date, no interest is charged. Hence, the customer can repay the loan within a maximum of 55 days and be charged no interest.

Generally, credit cards without an interest-free period have a lower interest rate than those with an interest-free period. These cards, however, generally attract an annual fee. This annual fee can in some cases be waived if a certain amount is spent on the card over the year.

The minimum monthly repayment on most credit cards is 5% of the outstanding balance, or \$10, whichever is greater.

WORKED Example 11

On Trevor's credit card statement he has an outstanding balance of \$1148.50. The minimum monthly payment is 5% of the outstanding balance, or \$10, whichever is greater. Calculate the minimum repayment that Trevor must make.

THINK

- 1 Calculate 5% of the outstanding balance.
- 2 Decide which repayment is greater and give a written answer.

WRITE

$$5\% \text{ of } \$1148.50 = \$57.43$$

The minimum repayment is \$57.43.

Credit card interest is quoted as an annual amount but is added monthly. To calculate the interest due, calculate one month's interest on the outstanding balance..

WORKED Example 12

The outstanding balance on a credit card is \$2563.75. If the full balance is not paid by the due date, one month's interest will be added at a rate of 18% p.a. Calculate the amount of interest that will be added to the credit card.

THINK

Use the simple interest formula to calculate one month's interest.

WRITE

$$\begin{aligned} I &= Prn \\ &= \$2563.75 \times 0.18 \times \frac{1}{12} \\ &= \$38.46 \end{aligned}$$

In practice, most credit cards calculate interest on the outstanding balance at a daily rate and then add the interest monthly. If a credit card advertises its interest rate as 18% p.a., the daily rate is 0.049 315%. To work out the interest, you will need to count the number of days that the credit card has each different balance over the month.

WORKED Example 13

An extract from a credit card statement is shown below.

Interest rate = 15% p.a. Daily rate = 0.041 096%

Date	Credit	Debit	Balance
1 June			\$900
10 June	\$400 – repayment		\$500
15 June		\$350 – purchase	\$850
22 June		\$140 – purchase	\$990
1 July		??? – interest	

Calculate the interest that will be due for the month of June.

THINK

- For 1 June – 9 June inclusive (9 days), the balance owing is \$900. Calculate the interest.
- For 10 June – 14 June inclusive (5 days), the balance owing is \$500. Calculate the interest.
- For 15 June – 21 June inclusive (7 days), the balance owing is \$850. Calculate the interest.
- For 22 June – 30 June inclusive (9 days), the balance owing is \$990. Calculate the interest.
- Add each amount of interest to calculate the total interest for the month.

WRITE

$$\begin{aligned} I &= 0.041\,096\% \text{ of } \$900 \times 9 \\ &= \$3.33 \\ I &= 0.041\,096\% \text{ of } \$500 \times 5 \\ &= \$1.03 \\ I &= 0.041\,096\% \text{ of } \$850 \times 7 \\ &= \$2.45 \\ I &= 0.041\,096\% \text{ of } \$990 \times 9 \\ &= \$3.66 \\ \text{Total interest} &= \$3.33 + \$1.03 \\ &\quad + \$2.45 + \$3.66 \\ &= \$10.47 \end{aligned}$$



Graphics Calculator **tip!**

Calculating interest on a daily basis

When doing this type of question where we need to consider interest calculated on a daily basis the **TVM** mode of your calculator is very useful. Consider the method shown below for worked example 13.

1. From the **MENU** of your calculator select **TVM**.



2. Press **(F1)** to select **Simple Interest**.



3. For 9 days the balance is \$900, so enter:

$n = 9$
 $I\% = 15$
 $PV = -900$



4. Press **(F1) (SI)** to get the interest for these 9 days.



Interest = \$3.33

5. For 5 days the balance is \$500. Press **(EXIT)** to return to the previous screen; change the values of n and PV .

$n = 5$
 $I\% = 15$
 $PV = -500$



Interest = \$1.03

Then press **(F1)** for the simple interest.

6. For 7 days the balance is \$850. Press **(EXIT)** to return to the previous screen; change the values of n and PV .

$n = 7$
 $I\% = 15$
 $PV = -850$



Interest = \$2.45

Then again press **(F1)** for the simple interest.

7. For 9 days the balance is \$990. Press **EXIT** to return to the previous screen; change the values of **n** and **PV**.

$$n = 9$$

$$I\% = 15$$

$$PV = -990$$

Then again press **F1** for the simple interest.



Interest = \$3.66

8. Add each amount of interest to find the total amount of interest for the month.
- | |
|-------------------------------------|
| Total interest |
| = \$3.33 + \$1.03 + \$2.45 + \$3.66 |
| = \$10.47 |

When deciding which credit card is most suitable for your needs, consider if you will generally be able to pay most items off before the interest-free period expires. The total cost in interest over a year will vary according to the repayment pattern.

WORKED Example 14

Kerry has a credit card with an interest-free period and interest is then charged on the outstanding balance at a rate of 18% p.a. Kerry pays a \$1200 bill for her council rates on her credit card.

- a** Kerry pays \$600 by the due date. What is the outstanding balance on the card?
- b** Calculate the interest Kerry must then pay for the second month.
- c** An alternative credit card charges 12% p.a. interest with no interest-free period. Calculate the interest that Kerry would have been charged on the first month.
- d** Calculate the balance owing after Kerry pays \$600 then calculate the interest for the second month.
- e** Which credit card would be the cheapest to use for this bill?

THINK

- a** Subtract the repayment from the balance.
- b** Use the simple interest formula to calculate one month's interest.
- c** Use the simple interest formula to calculate the first month's interest.
- d**
 - 1 Add the interest to the amount of the bill and subtract the repayment.
 - 2 Use the simple interest formula to calculate the second month's interest.
- e** Add the two months of interest together for the second card and compare with the interest for the first card.

WRITE

- a** Balance owing = $\$1200 - \600
= \$600
- b** $I = Prn$
= $\$600 \times 0.18 \times \frac{1}{12}$
= \$9.00
- c** $I = Prn$
= $\$1200 \times 0.12 \times \frac{1}{12}$
= \$12.00
- d** Balance owing = $\$1200 + \$12 - \$600$
= \$612
 $I = Prn$
= $\$612 \times 0.12 \times \frac{1}{12}$
= \$6.12
- e** The interest on the second card is \$18.12 and therefore the card with the interest-free period is cheaper in this case.

remember

1. A credit card is a source of an instant loan to the card holder.
2. The card is repaid monthly with the minimum payment usually 5% of the outstanding balance, or \$10, whichever is the greater.
3. There are many different types of credit card. The main difference between them is that some have an interest-free period while others charge interest from the date of purchase.
4. Cards without an interest-free period generally have a lower rate of interest than those with an interest-free period.
5. The interest on a credit card is usually calculated as a daily rate. This is found by dividing the annual rate by 365.
6. The **TVM** function on the graphics calculator can be used to calculate the monthly interest on a credit card.
7. To calculate the cheaper credit card, we need to consider the repayment plan that would be used.

EXERCISE 1D

Credit cards

WORKED Example 11

- 1 Roy has a credit card with an outstanding balance of \$2730. Calculate the minimum payment if he must pay 5% of the balance, or \$10, whichever is greater.
- 2 The minimum monthly repayment on a credit card is 5% of the balance, or \$10, whichever is greater. Calculate the minimum monthly repayment on a balance of:
 a \$3500 b \$1194.50 c \$492.76 d \$150 e \$920.52.

WORKED Example 12

- 3 Leonie has a credit card with an outstanding balance of \$1850. If the interest rate is 18% p.a., calculate the amount of interest that Leonie will be charged for one month if the balance is not paid by the due date.
- 4 Hassim buys a refrigerator for \$1450 with his credit card. The card has no interest-free period and interest is charged at a rate of 15% p.a. Calculate one month's interest on this purchase.
- 5 Michelle has a \$2000 outstanding balance on her credit card. The interest rate charged is 21% p.a. on the balance unpaid by the due date.
 - a If Michelle pays \$200 by the due date, calculate the balance owing.
 - b Calculate the interest that Michelle will owe for the next month.
 - c What will be the balance owing on Michelle's next credit card statement?
 - d What will be the total amount owing on the credit card after another month's interest is added?
- 6 Chandra has a credit card which charges interest at a rate of 12% p.a. but has no interest-free period. He makes a purchase of \$1750 on the credit card.
 - a After one month Chandra's credit card statement arrives. What will be the outstanding balance on the statement?
 - b The minimum repayment will be 5% of the outstanding balance. Calculate the amount that Chandra will owe if he makes only the minimum payment.
 - c In the next month Chandra makes purchases totalling \$347.30. Calculate the interest charged and the balance owing for the next month's statement.

**WORKED
Example****13**

7 An extract of a credit card statement is shown below. Take 1 year = 365.25 days.

Interest rate = 18% p.a. Daily rate = 0.049 28%

Date	Credit (\$)	Debit (\$)	Balance (\$)
1 July			256.40
10 July		40 – purchase	
20 July	40 – repayment		
1 August		??? – interest	

a Complete the balance column. Calculate the balance owing on 10 July and 20 July.

b Calculate the interest due on 1 August and the balance on that date.

8 Study the credit card statement below.

Interest rate = 16.5% p.a. Daily rate = _____

Date	Credit (\$)	Debit (\$)	Balance (\$)
1 Jan.			1548.50
8 Jan.	500 – repayment		
15 Jan.		399 – purchase	
1 Feb.		??? – interest	
8 Feb.	??? – repayment		
1 March		??? – interest	

a Calculate the daily rate of interest, correct to 4 decimal places (take 1 year = 365.25 days).

b Calculate the interest added to the account on 1 February.

c On 8 February the minimum repayment of 5% is made. Calculate the amount of this repayment.

d Calculate the outstanding balance on the account on 1 March.

**WORKED
Example****14**

9 Kai has two credit cards. One has an interest-free period and interest is then charged on the outstanding balance at a rate of 18% p.a. The other has no interest-free period with interest added from the date of purchase at a rate of 14% p.a. Kai has \$1500 worth of bills to pay in the coming month and intends to use one of the cards to pay them, then pay the balance off in monthly instalments of \$500.

a If Kai uses the card with the interest-free period and pays \$500 by the due date, what is the outstanding balance on the card?

b Calculate the interest Kai must then pay for the second month.

c Calculate the balance owing at the end of the second month and the balance owing at the end of the third month, at which time Kai pays off the entire balance.

d Calculate the interest payable in the first month if Kai uses the card without the interest-free period.

e Calculate the balance owing after Kai pays \$500 then calculate the interest for the second month.

f Calculate the balance owing at the end of the second month and the balance owing at the end of the third month, at which time Kai pays off the entire balance.

g Which card should Kai use for these bills?

Researching credit cards

Find out about the costs associated with two credit cards. One of the cards should have an interest-free period and the other no interest-free period. Find out:

- 1 if there is an annual fee associated with having the card
- 2 the interest rate on each card
- 3 the minimum monthly payment to be made on each card
- 4 what credit limits apply to a first-time credit card holder
- 5 what benefits such as 'Fly-Buys' or 'Frequent Flyer Points' can be obtained from use of the card
- 6 any other relevant information about the card.

10 QUICK QUESTIONS 2

- 1 Calculate the amount of flat rate interest payable on a loan of \$4500 at 21% p.a. over a 3 year term.
- 2 A loan of \$2000 is repaid over 1 year at a rate of \$100 per week. Calculate the rate of interest charged on the loan.
- 3 A loan of \$120 000 at 11% p.a. reducible over 20 years is repaid at \$1238.63 per month. The bank also charges an \$8 per month account management fee. Calculate the total cost of repaying the loan.
- 4 A loan of \$5000 is advertised at a rate of 9% p.a. flat rate interest for a term of 4 years. Use the formula $E = \frac{(1+r)^n - 1}{n}$ to calculate the effective rate of interest on this loan (correct to 1 decimal place).
- 5 A loan of \$10 000 at 11% p.a. reducible interest is repaid over 4 years at a rate of \$258.46 per month. Calculate the equivalent flat rate of interest charged on the loan (correct to 1 decimal place).
- 6 With reference to credit cards, what is meant by the term *interest-free period*?
- 7 The minimum repayment on a credit card is 5% or \$10, whichever is greater. Calculate the minimum repayment for July that is to be made on a card with an outstanding balance of \$3297.50.
- 8 On the credit card in question 7, a repayment of \$500 is made by the due date. Calculate the interest that will be charged for August at the rate of 18% p.a.
- 9 An alternative credit card with no interest-free period has an interest rate of 12% p.a. Calculate the interest on the above credit card for July at this rate.
- 10 Calculate the total interest that would have been charged for 2 months assuming a \$500 payment was made on 1 August.

Loan repayments

With a reducing balance loan, an amount of interest is added to the principal each month and then a repayment is made which is then subtracted from the outstanding balance. Consider the case below of a \$2000 loan at 15% p.a. to be repaid over 1 year in equal monthly instalments of \$180.52.

Month	Opening balance	Interest	Closing balance
1	\$2000.00	\$25.00	\$1844.48
2	\$1844.48	\$23.06	\$1687.02
3	\$1687.02	\$21.09	\$1527.59
4	\$1527.59	\$19.09	\$1366.17
5	\$1366.17	\$17.08	\$1202.73
6	\$1202.73	\$15.03	\$1037.25
7	\$1037.25	\$12.97	\$ 869.70
8	\$ 869.70	\$10.87	\$ 700.05
9	\$ 700.05	\$ 8.75	\$ 528.29
10	\$ 528.29	\$ 6.60	\$ 354.37
11	\$ 354.37	\$ 4.43	\$ 178.29
12	\$ 178.29	\$ 2.23	-\$ 0.00

The actual calculation of the amount to be repaid each month to pay off the loan plus interest in the given period of time is beyond this course. The most practical way to find the amount of each monthly repayment is to use a table of repayments.



Monthly repayment per \$1000 borrowed

	Interest rate										
Year	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	\$85.61	\$86.07	\$86.53	\$86.99	\$87.45	\$87.92	\$88.38	\$88.85	\$89.32	\$89.79	\$90.26
2	\$43.87	\$44.32	\$44.77	\$45.23	\$45.68	\$46.14	\$46.61	\$47.07	\$47.54	\$48.01	\$48.49
3	\$29.97	\$30.42	\$30.88	\$31.34	\$31.80	\$32.27	\$32.74	\$33.21	\$33.69	\$34.18	\$34.67
4	\$23.03	\$23.49	\$23.95	\$24.41	\$24.89	\$25.36	\$25.85	\$26.33	\$26.83	\$27.33	\$27.83
5	\$18.87	\$19.33	\$19.80	\$20.28	\$20.76	\$21.25	\$21.74	\$22.24	\$22.75	\$23.27	\$23.79
6	\$16.10	\$16.57	\$17.05	\$17.53	\$18.03	\$18.53	\$19.03	\$19.55	\$20.07	\$20.61	\$21.15
7	\$14.13	\$14.61	\$15.09	\$15.59	\$16.09	\$16.60	\$17.12	\$17.65	\$18.19	\$18.74	\$19.30
8	\$12.66	\$13.14	\$13.63	\$14.14	\$14.65	\$15.17	\$15.71	\$16.25	\$16.81	\$17.37	\$17.95
9	\$11.52	\$12.01	\$12.51	\$13.02	\$13.54	\$14.08	\$14.63	\$15.18	\$15.75	\$16.33	\$16.92
10	\$10.61	\$11.10	\$11.61	\$12.13	\$12.67	\$13.22	\$13.78	\$14.35	\$14.93	\$15.53	\$16.13
11	\$ 9.86	\$10.37	\$10.88	\$11.42	\$11.96	\$12.52	\$13.09	\$13.68	\$14.28	\$14.89	\$15.51
12	\$ 9.25	\$ 9.76	\$10.28	\$10.82	\$11.38	\$11.95	\$12.54	\$13.13	\$13.75	\$14.37	\$15.01
13	\$ 8.73	\$ 9.25	\$ 9.78	\$10.33	\$10.90	\$11.48	\$12.08	\$12.69	\$13.31	\$13.95	\$14.60
14	\$ 8.29	\$ 8.81	\$ 9.35	\$ 9.91	\$10.49	\$11.08	\$11.69	\$12.31	\$12.95	\$13.60	\$14.27
15	\$ 7.91	\$ 8.44	\$ 8.99	\$ 9.56	\$10.14	\$10.75	\$11.37	\$12.00	\$12.65	\$13.32	\$14.00
16	\$ 7.58	\$ 8.11	\$ 8.67	\$ 9.25	\$ 9.85	\$10.46	\$11.09	\$11.74	\$12.40	\$13.08	\$13.77
17	\$ 7.29	\$ 7.83	\$ 8.40	\$ 8.98	\$ 9.59	\$10.21	\$10.85	\$11.51	\$12.19	\$12.87	\$13.58
18	\$ 7.03	\$ 7.58	\$ 8.16	\$ 8.75	\$ 9.36	\$10.00	\$10.65	\$11.32	\$12.00	\$12.70	\$13.42
19	\$ 6.80	\$ 7.36	\$ 7.94	\$ 8.55	\$ 9.17	\$ 9.81	\$10.47	\$11.15	\$11.85	\$12.56	\$13.28
20	\$ 6.60	\$ 7.16	\$ 7.75	\$ 8.36	\$ 9.00	\$ 9.65	\$10.32	\$11.01	\$11.72	\$12.44	\$13.17
21	\$ 6.42	\$ 6.99	\$ 7.58	\$ 8.20	\$ 8.85	\$ 9.51	\$10.19	\$10.89	\$11.60	\$12.33	\$13.07
22	\$ 6.25	\$ 6.83	\$ 7.43	\$ 8.06	\$ 8.71	\$ 9.38	\$10.07	\$10.78	\$11.50	\$12.24	\$12.99
23	\$ 6.10	\$ 6.69	\$ 7.30	\$ 7.93	\$ 8.59	\$ 9.27	\$ 9.97	\$10.69	\$11.42	\$12.16	\$12.92
24	\$ 5.97	\$ 6.56	\$ 7.18	\$ 7.82	\$ 8.49	\$ 9.17	\$ 9.88	\$10.60	\$11.34	\$12.10	\$12.86
25	\$ 5.85	\$ 6.44	\$ 7.07	\$ 7.72	\$ 8.39	\$ 9.09	\$ 9.80	\$10.53	\$11.28	\$12.04	\$12.81

The table shows the monthly repayment on a \$1000 loan at various interest rates over various terms. To calculate the repayment on a loan, we simply multiply the repayment on \$1000 by the number of thousands of dollars of the loan.

WORKED Example 15

Calculate the monthly repayment on a loan of \$85 000 at 11% p.a. over a 25-year term.

THINK

- 1 Look up the table to find the monthly repayment on \$1000 at 11% p.a. for 25 years.
- 2 Multiply this amount by 85.

WRITE

$$\begin{aligned}\text{Monthly repayment} &= \$9.80 \times 85 \\ &= \$833\end{aligned}$$

This table can also be used to make calculations such as the effect that interest rate rises will have on a home loan.

WORKED Example 16

The Radley family borrow \$160 000 for a home at 8% p.a. over a 20-year term. They repay the loan at \$1400 per month. If the interest rate rises to 9%, will they need to increase their repayment and, if so, by how much?

THINK

- 1 Look up the table to find the monthly repayment on \$1000 at 8% p.a. for 20 years.
- 2 Multiply this amount by 160.
- 3 If this amount is greater than \$1400, state the amount that the repayment needs to rise.

WRITE

$$\begin{aligned}\text{Monthly repayment} &= \$9.00 \times 160 \\ &= \$1440.00\end{aligned}$$

The Radley family will need to increase their monthly repayments by \$40.

remember

1. The amount of each monthly repayment is best determined by using a table of repayments.
2. The amount of each repayment is calculated by multiplying the monthly repayment on a \$1000 loan by the number of thousands of the loan.

EXERCISE 1E**Loan repayments****WORKED Example 15**

- 1 Use the table of repayments on page 30 to calculate the monthly repayment on a \$75 000 loan at 7% p.a. over a 15-year term.
- 2 Use the table of repayments to calculate the monthly repayment on each of the following loans.
 - a \$2000 at 8% p.a. over a 2-year term
 - b \$15 000 at 13% p.a. over a 5-year term
 - c \$64 000 at 15% p.a. over a 25-year term
 - d \$100 000 at 12% p.a. over a 20-year term
 - e \$174 000 at 9% p.a. over a 22-year term



- 3 Jenny buys a computer for \$4000 on the following terms: 10% deposit with the balance paid in equal monthly instalments over 3 years at an interest rate of 14% p.a.
- Calculate Jenny's deposit.
 - Calculate the balance owing on the computer.
 - Use the table of repayments to calculate the amount of each monthly repayment.

**WORKED
Example**
16

- 4 Mr and Mrs Dubois borrow \$125 000 over 20 years at 10% p.a. to purchase a house. They repay the loan at a rate of \$1500 per month. If the interest rate rises to 12% p.a., will Mr and Mrs Dubois need to increase the size of their repayments and, if so, by how much?

- 5 Mr and Mrs Munro take out a \$180 000 home loan at 9% p.a. over a 25-year term.

- Calculate the amount of each monthly repayment.
- After 5 years the balance on the loan has been reduced to \$167 890. The interest rate then rises to 10% p.a. Calculate the new monthly repayment required to complete the loan within the existing term.

- 6 A bank will lend customers money only if they believe the customer can afford the repayments. To determine this, the bank has a rule that the maximum monthly repayment a customer can afford is 25% of his or her gross monthly pay. Darren applies to the bank for a loan of \$62 000 at 12% p.a. over 15 years. Darren has a gross annual salary of \$36 000. Will Darren's loan be approved? Use calculations to justify your answer.



- 7 Tracey and Barry have a combined gross income of \$84 000.
- Calculate Tracey and Barry's gross monthly income.
 - Using the rule applied in the previous question, what is the maximum monthly repayment on a loan that they can afford?
 - If interest rates are 11% p.a., calculate the maximum amount (in thousands) that they could borrow over a 25-year term.
- 8 Mr and Mrs Yousef borrow \$95 000 over 25 years at 8% p.a. interest.
- Calculate the amount of each monthly repayment on the loan.
 - Mr and Mrs Yousef hope to pay the loan off in a much shorter period of time. By how much will they need to increase the monthly repayment to pay the loan off in 15 years?
- 9 Mr and Mrs Bath borrow \$375 000 at 8% p.a. reducible over a 25-year term, with repayments to be made monthly.
- Calculate the amount of each monthly repayment.
 - Calculate the total amount that Mr and Mrs Bath will repay over the term of the loan.
 - What is the total amount of interest that Mr and Mrs Bath will pay on the loan?
 - Calculate the average amount of interest that Mr and Mrs Bath will pay each year.
 - Calculate the equivalent flat rate of interest by expressing your answer to part d as a percentage of the amount borrowed.

- 10** A loan of \$240 000 is taken out over a 25-year term at an interest rate of 7% p.a. reducible.
- Calculate the amount of each monthly repayment.
 - Calculate the total repayments made on the loan.
 - Calculate the amount of interest paid on the loan.
 - Find the equivalent flat rate of interest.
 - By following steps **a** to **d** above calculate the equivalent flat rate of interest if the term of the loan is:
 - 20 years
 - 15 years.



Computer Application 3 Loan repayments

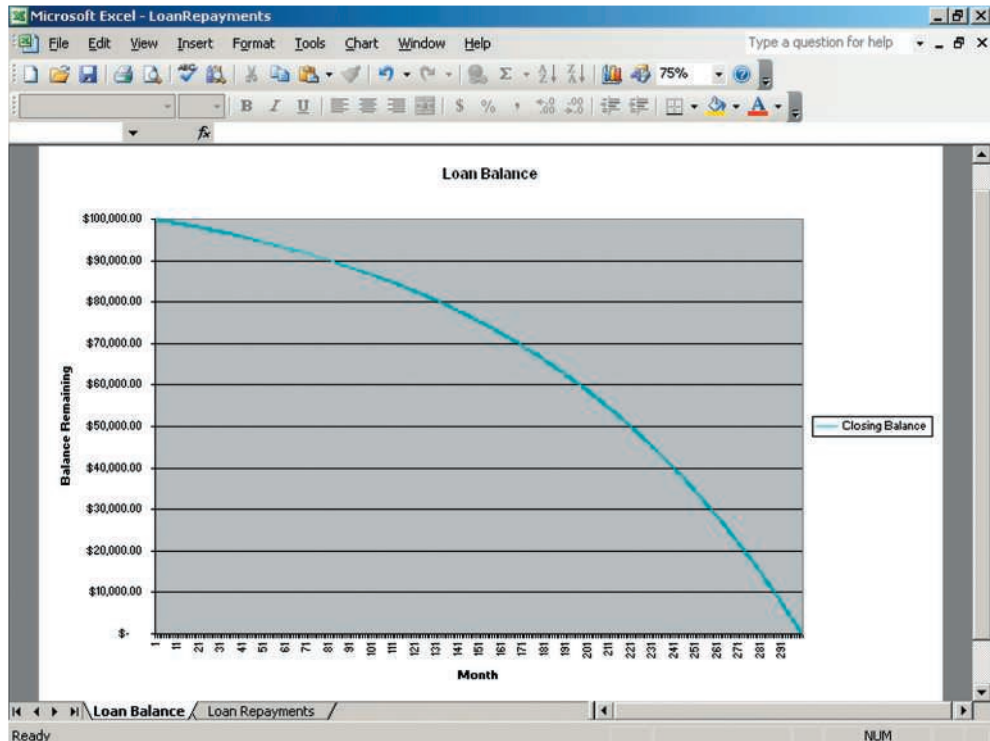
Access the spreadsheet *Loan Repayments* from the *Maths Quest General Mathematics HSC Course* CD-ROM. This spreadsheet shows the graph of a home loan of \$100 000 at 9% p.a. that is repaid over 25 years. Use the graph to determine how long it takes for the outstanding balance to reduce to:

- \$80 000
- \$50 000
- \$20 000.

Next, change the amount borrowed in the spreadsheet to \$200 000. Does it take the same length of time for the outstanding balance to be halved?

Change the interest rate to 12% p.a. and the amount borrowed back to \$100 000. Does it still take the same length of time for the balance to be halved?

Experiment with different loans and look for a pattern in the way in which the balance of the loan reduces.



summary

Flat rate interest

- A flat rate loan is one where interest is calculated based on the amount initially borrowed.
- Flat rate loans have the interest calculated using the simple interest formula:
$$I = Prn \quad \text{③}$$
- The total repayments on a flat rate loan are calculated by adding the interest to the amount borrowed.
- The monthly or weekly repayments on a flat rate loan are calculated by dividing the total repayments by the number of weeks or months in the term of the loan.

Home loans

- The interest of home loans is calculated at a reducible rate. This means that the interest is calculated on the outstanding balance at the time and not on the initial amount borrowed.
- The interest on home loans is usually calculated and added monthly while repayments are calculated on a monthly basis.
- To calculate the total cost of a home loan, we multiply the amount of each monthly payment by the number of payments.

The cost of a loan

- To compare a flat rate loan with a reducing balance loan, the equivalent reducing balance interest rate can be calculated using the formula:

$$E = \frac{(1 + r)^n - 1}{n}$$

- When comparing two or more loans, the most accurate comparison is done by calculating the total cost of repaying the loan.
- A loan that is repaid over a shorter period of time will generally cost less even if the interest rate may be slightly higher.
- The flexibility of loan repayments is an important consideration when calculating the cost of a loan.
- When calculating the cost of a loan, fees such as application fee and account management fees must be considered along with the interest payable.

Credit cards

- A credit card is a pre-approved loan up to a certain amount called the credit limit.
- There are many kinds of credit cards and the most important difference is that some cards have an interest-free period while others attract interest from the date of purchase.
- Credit cards without an interest-free period generally have a lower rate of interest than those with an interest-free period.

- Each credit card will have a monthly statement and will require a minimum payment each month.
- When evaluating the best credit card for your circumstances, you need to consider if you will be able to pay most bills by the due date and consider any fees attached to the card.

Loan repayments

- The amount of each monthly repayment is best calculated using a table of monthly repayments.
- The monthly repayment on a \$1000 loan at the given rate over the given term is then multiplied by the number of thousands of the loan to find the size of each repayment.

CHAPTER

review

1A

1A

1A

1A

1B

1B

- 1 Calculate the amount of flat rate interest that will be paid on each of the following loans.
 - a \$8000 at 7% p.a. for 2 years
 - b \$12 500 at 11.5% p.a. for 5 years
 - c \$2400 at 17.8% p.a. for 3 years
 - d \$800 at 9.9% p.a. over 6 months
 - e \$23 400 at 8.75% p.a. over 6 years
- 2 Calculate the total repayments made on a loan of \$4000 at 23% p.a. flat rate interest to be repaid over 3 years.
- 3 Noel borrows \$5600 at 7.6% p.a. flat rate interest to be repaid in monthly instalments over 3 years. Calculate the amount of each monthly instalment.
- 4 Shane borrows \$9500 to purchase a new car. He repays the loan over 4 years at a rate of \$246.60 per month. Calculate the flat rate of interest charged on the loan.
- 5 Mr and Mrs Smith borrow \$125 000 to purchase a home. The interest rate is 12% p.a. and the monthly repayments are \$1376.36. Calculate:
 - a the first month's interest on the loan
 - b the balance of the loan after the first month.
- 6 Mr and Mrs Buckley borrow \$130 000 to purchase a home. The interest rate is 8% p.a. and over a 20-year term the monthly repayment is \$1087.37.
 - a Copy and complete the table below.

Month	Principal (\$)	Interest (\$)	Balance (\$)
1	130 000.00	866.67	129 779.29
2	129 779.29		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

- b** Mr and Mrs Buckley decide to increase their monthly payment to \$1500. Complete the table below.

Month	Principal (\$)	Interest (\$)	Balance (\$)
1	130 000.00	866.67	129 366.67
2	129 366.67		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

- c** How much less do Mr and Mrs Buckley owe at the end of one year by increasing their monthly repayment?
- 7** Mr and Mrs Stone borrow \$225 000 for their home. The interest rate is 9.6% p.a. and the term of the loan is 25 years. The monthly repayment is \$1989.48.
- a** Calculate the total repayments made on this loan.
- b** If Mr and Mrs Stone increase their monthly payments to \$2000, the loan will be repaid in 24 years and 1 month. Calculate the amount they will save in repayments with this increase.
- 8** Use the formula $E = \frac{(1+r)^n - 1}{n}$ to calculate the effective interest rate on each of the following flat rate loans (answer correct to 2 decimal places).
- a** \$4000 at 7% p.a. over 2 years **b** \$12 000 at 11% p.a. over 5 years
- c** \$1320 at 23% p.a. over 2 years **d** \$45 000 at 9.2% p.a. over 10 years
- 9** Yu-Ping borrows \$13 500 for a holiday to Africa at 12.5% p.a. reducible interest over a 5-year term. The monthly repayments on the loan are \$303.72.
- a** Calculate the total repayments on the loan.
- b** Calculate the amount of interest that Yu-Ping pays on the loan.
- c** Calculate the equivalent flat rate of interest on the loan.

1B

1C

1C

1C

- 10** Kristen and Adrian borrow \$150 000 for their home. They have the choice of two loans.
 Loan 1: At 8% p.a. interest over 25 years with fixed repayments of \$1157.72.
 Loan 2: At 8.25% p.a. interest over 25 years with minimum repayments of \$1182.68 and an \$8 per month account management fee.

Kristen and Adrian believe they can afford to pay \$1500 per month. If they do, Loan 2 will be repaid in 14 years and 2 months. Which loan should Kristen and Adrian choose if they can afford to pay the extra each month?

1C

- 11** Stephanie has a credit card with an outstanding balance of \$423. Calculate the minimum payment that must be made if she must pay 5% of the balance, or \$10, whichever is greater.

1D

- 12** Lorenzo has a credit card with an outstanding balance of \$850. If the interest rate is 24% p.a., calculate the amount of interest that Lorenzo will be charged if the balance is not paid by the due date.

1D

- 13** Jessica pays for her car repairs, which total \$256.50, using her credit card. The credit card has an interest rate of 15% p.a. and interest is charged from the date of purchase. Calculate the amount of interest charged after one month on this card.

1D

- 14** Study the extract from the credit card statement below.

Interest rate = 19.5% p.a. Daily rate = _____

Date	Credit (\$)	Debit (\$)	Balance (\$)
1 Jan.			2584.75
6 Jan.	600 – repayment		
15 Jan.		39.99 – purchase	
1 Feb.		??? – interest	
8 Feb.	??? – repayment		
15 Feb.		425.85 – purchase	
1 March		??? – interest	

- Calculate the daily rate of interest. (Take 1 year = 365.25 days and answer correct to 4 decimal places.)
- Calculate the interest due for January.
- If the minimum monthly payment of 5% of the outstanding balance is made on 8 February, calculate the amount of this repayment.
- Calculate the interest for February.

1E

- 15** Use the table of repayments on page 30 to calculate the monthly repayment on each of the following loans.
- \$25 000 at 9% p.a. over a 10-year term
 - \$45 000 at 14% p.a. over a 15-year term
 - \$164 750 at 15% p.a. over a 25-year term
 - \$425 000 at 12% p.a. over a 15-year term

1E

- 16** Mr and Mrs Rowe take out a \$233 000 home loan at 12% p.a. over a 25-year term.
- Use the table of repayments to calculate the amount of each monthly repayment.
 - After 3 years the balance on the loan has been reduced to \$227 657. The interest rate then rises to 13% p.a. Calculate the new monthly repayment required to complete the loan within the existing term.

Practice examination questions

1 multiple choice

The total repayments for a \$3400 loan on a flat rate interest of 8.5% p.a. over a 3-year period are:

- A \$867 B \$942.78 C \$4267 D 4342.78

2 multiple choice

A \$115 000 loan is repaid over a 25-year term at the rate of \$1211.21 per month. The total amount of interest that is paid on this loan is:

- A \$30 280.25 B \$145 280.25 C \$248 363.00 D \$363 363.00

3 multiple choice

A \$150 000 loan is to be taken out. Which of the following loans will have the lowest total cost?

- A 4% p.a. flat rate interest to be repaid over 20 years
 B 8% p.a. reducible interest to be repaid over 20 years at \$1254.66 per month
 C 9% p.a. reducible interest to be repaid over 15 years at \$1521.40 per month
 D 8.5% p.a. reducible interest to be repaid over 15 years at \$1512.49 per month with a \$900 loan application fee and \$12 per month account management fee

4 multiple choice

Look at the table of loan repayments per \$1000 shown below.

	Interest rate (p.a.)			
Term	9%	10%	11%	12%
10	\$12.67	\$13.22	\$13.78	\$14.35
15	\$10.14	\$10.75	\$11.37	\$12.00
20	\$9.00	\$9.65	\$10.32	\$11.01
25	\$8.39	\$9.09	\$9.80	\$10.53

Daniel has an \$80 000 mortgage at 10% p.a. over 10 years. After interest rates rise to 12% Daniel extends the term of his loan to 15 years. What is the change in Daniel's monthly repayments?

- A They increase by \$1.13 per month. B They decrease by \$1.22 per month.
 C They increase by \$90.40 per month. D They decrease by \$97.60 per month.

5 David buys a computer that has a cash price of \$4600. David pays 10% deposit with the balance in weekly instalments at 13% p.a. flat rate interest over a period of 4 years.

- a Calculate the balance owing after David has paid the deposit.
 b Calculate the total repayments that David must make on this loan.
 c Calculate the amount of each weekly instalment
 d Use the formula $E = \frac{(1+r)^n - 1}{n}$ to calculate the equivalent reducible interest rate on this loan.

- 6 Mr and Mrs Tarrant borrow \$186 500 to purchase a home. The interest rate is 9% p.a. and the loan is over a 20-year term.
- a Use the table below to calculate the amount of each monthly repayment.

	Interest rate (p.a.)			
Term	9%	10%	11%	12%
10	\$12.67	\$13.22	\$13.78	\$14.35
15	\$10.14	\$10.75	\$11.37	\$12.00
20	\$9.00	\$9.65	\$10.32	\$11.01
25	\$8.39	\$9.09	\$9.80	\$10.53

- b Calculate the total amount that they can expect to make in repayments.
- c After 10 years the outstanding balance is \$132 463 and the interest rate is increased to 11%. Calculate the amount of the monthly repayment they will need to make to complete the loan within the term.
- d The loan has a \$5 per month account management fee. The Tarrants also had a \$400 loan application fee and \$132.75 in stamp duty to pay in establishing the loan. Calculate the total cost of the loan after 20 years.
- 7 Paul has a credit card that has an interest-free period. The interest rate is 21% p.a.
- a If Paul has an outstanding balance of \$275.50, calculate the minimum payment he must make by the due date if it is 5% of the balance, or \$10, whichever is greater.
- b If Paul pays only the minimum balance by the due date, calculate the balance owing for the next month.
- c Calculate the interest that Paul will be charged on his next month's statement.
- d If Paul pays the whole balance off next month, is this card cheaper than a card without an interest-free period but an interest rate of 15% p.a.? Use calculations to justify your answer.